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HANDLE WITH CARE

MANAGING REQUIRED OF GOVERNMENT AND INDUSTRY TO GAIN AFFORDABILITY

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Abstract

The term affordability has become one of the latest buzz words to enter the vernacular of the defense community. It is the purpose of this paper to explore the roles of both government and industry in managing resources to realize the benefits of affordability. In keeping with the stated topic for this segment of the conference, "Innovations Leading to Affordability," several ideas are examined to bring affordability to National Missile Defense (NMD) and Theater Missile Defense (TMD) systems. The government, including the military services, must make longer term commitments to weapon systems acquisitions and maintain consistency of the funding profile over the life of the programs. Industry, with some innovations, has extensive opportunities to revise the industry/corporate culture to capitalize on potential costs reductions. Once the affordability roles for government/military services and their industry partners have been explored, attention is given to those contributions that industry can reasonably provide.

The introduction of integrated product development (IPD) provides a vehicle for implementing a partnership among all participants when a contract has been awarded to enable the convergence on affordable weapon systems. It is essential that this partnership be forged and maintained to add practical meaning and significance to the term affordability.

The Concept of Affordability Applied to Aerospace Weapon Systems

Affordability has had dissimilar meanings to various users of the label. Those in government frequently view affordability as a commodity to be delivered by contractors to force-fit program costs to a funding profile based on resources made available by congress. This is usually done in the absence of a fit with a carefully developed probable cost to deliver the system. Industry, on the other hand, has treated affordability as an arbitrary reduction in the poorly defined probable cost to deliver the system that stemmed from the attitudes encountered in contacts with Government officials. *Webster's Third New International Dictionary*, defines affordability as, "1a) to afford is to manage to bear (the cost) without serious detriment," and "1b) to manage to pay for or incur the cost of." Webster is correct and in recent years government and industry have formed a partnership to realize the true benefits of affordability just as defined in our dictionaries.

Affordability is a management issue. A new culture has evolved in industry and in government dedicated to seeking methods of reducing costs through innovations on the broad front of production, delivery and operational support of weapon systems. The Honorable Dr. Paul G. Kaminski, Under Secretary of Defense for Acquisition and Technology, has taken a leading role in the quest for affordability in the name of acquisition reform. Leaders in the aerospace industry have similarly implemented measures to seek avenues to affordability in the name of surviving downsizing. These are in reality a single initiative that created the basis for a partnership between government and industry that is necessary to move toward essential changes in how we operate.

A manifestation of the interest from industry in affordability improvements is found in the *Multi-Association Industry Affordability Task Force*. The purpose of the task force is to develop, communicate and advocate focused industry input to the DOD on an integrated business, technical and industrial base strategy which will meet the needs for superior affordable weapons in a declining budget environment. This would seem a monumental undertaking and yet a little investigation reveals that the opportunities in our aerospace world for innovation are endless. Accomplishments to date are indicative of the power available to government and industry through cooperation in the pursuit of affordable weapons systems.

The principal roadblock to open cooperation between the government services and contractors in the quest for affordable weapons systems are the antiquated government regulations dealing with competitive procurements. While one can hear much dialogue about acquisition reform in every industry meeting and from every industry publication, little real progress has been achieved. The Federal Acquisition Regulations (FARs), the defense department parallel, the Defense Federal Acquisition Regulations (DFARs), and Services corresponding regulations have remained essentially unchanged for years. It is unlikely that change will come about without serious upheaval in the government. Too many government bureaucrats are comfortable with the status quo and change frequently leads to loss of jobs, a fact now well recognized on the industry side. If what is deemed by some to be an inappropriate level of closeness between the government-military and contractors during work is observed, government agencies are prone to lean over backwards to limit in some manner or punish involved contractors in order to avoid protest. On the other hand this same close, clear communication that is

feared is the key to gaining affordable weapon systems. A crying need exists to accelerate the implementation of streamlined acquisition measures designed to enable a competitive selection of a contractor for a task followed by the completely open government/contractor team approach consistent with the integrated product development (IPD) process. Indeed, once an award has been made on whatever basis, new ideas that contribute to cost reduction must be embraced even if a very different approach results than that originally bid. It is crucial in this new era of cost reductions through innovation that after contract award relationships between government and its contractors be open and unconstrained by artificial rules and holdovers from earlier times designed to forestall protests from unsuccessful bidders. We as a community must muster the fortitude to reach decisions and move forward briskly.

Figure 1 presents the concept of affordability applied to aerospace weapon systems.

- Affordability - to manage to bear the cost of a weapon system without detriment to established military budgets; "get the weapon for less"
- *Affordability is a management issue*
- A partnership is evolving between the Government-Military and industry to achieve more for less
- The key to affordability lies in finding innovative approaches to acquiring the hardware and software needed to formulate the weapon system
- Government-Military seeks methods of managing to reduce costs; Dr. Paul G. Kaminski, Under Secretary of Defense for Acquisition and Technology has taken a leading role in the name of "Acquisition Reform."
- Leaders in the aerospace industry are seeking and implementing innovative measures to achieve affordability and competitiveness in the name of "Surviving Downsizing"
- The Multi-Association Industry Affordability Task Force has been chartered to input to the DOD ideas for a broadbased strategy to gain affordability
- Antiquated Government regulations dealing with competitive procurements are a principal roadblock to progress; the FARs, the DFARs and corresponding Services regulations have remained essentially unchanged for literally years
- Closeness between Government-Military and contractors can lead to sanctions against contractors; the bureaucracy fears "compromise of a pending competition." This fear is in the way!
- Open relationships are needed prior to and after a contract award; we cannot get there without dramatic changes in processes and procedures on the part of Government-Military and industry
- The partnership must not be constrained by artificial rules and obsolete holdovers designed to forestall protests from unsuccessful bidders
- The Community as a whole simply must find the fortitude to reach decisions and move forward briskly

Figure 1. The Concept of Affordability Applied to Aerospace Weapon Systems

The Role of Government-Military in Achieving Affordable Weapon Systems

Figure 2 presents eight of the most important things that government-military leadership must address and publicize to encourage innovative efforts to acquire affordable systems. Not all of these measures are new; most have been in place for many years but are usually privately executed within the government. Typically they are poorly defined and publicized. This latter manifestation is one of the carry-overs from prior times; releases of procurement related

- Identification of needed military missions
- Characterizations of needed missions in terms of required capabilities and the hardware and software necessary to realization of required capabilities
- Placement of a value to the Government-Military of the acquisition of the needed equipment to perform the needed mission; this constitutes a topdown definition of the desired life cycle funding profile
- A stable life cycle demands consistency in the weapon system acquisition goals and objectives; the "key" to affordability
 - *Typically goals and objectives are not sustained as the turmoil of Service rivalries and national politics come into play*
 - *Affordability will continue to elude Government until such time as a means is found for enforcing discipline with regard to the definition of a system life cycle*
- Extract requirements from goals and objectives to drive the procurement of the weapon system; adjust procurement practices as necessary to efficiently complete acquisition.
- Implementation of contacts with qualified aerospace contractors in advance of a competition
 - Validate the acquisition approach on the bases of available technology, promising concepts and programmatic consistent with committed resources.
 - *Develop a means for totally open and even handed communications and interfaces by the procuring agency with all contenders*
- Eliminate layers of parasitic support contractors as a major step toward achieving affordable weapon systems
 - *The need for oversight to protect the interests of taxpayers is overblown by politicians and a media hostile to defense*
 - Typically a support contractor is a no-value-added entity that constitutes nothing more than a tax on the program
- Introduction of the use of Public Law to remove incessant perturbations to funding profiles

Figure 2. The Eight Most Important Items That Government-Military Must Address

information come out piecemeal, guarded, and stilted because of concerns about the yet-to-come competition and the prospects of protests by losing bidders. This artifact of information exchange must be eliminated in favor of full and open disclosure of the government-military requirements, plans, programmatics and funds available.

The first of government-military responsibilities is to assure defense of the nation through the identification of needs for military missions. This is an involved process that crosses all the Services in terms of the missions each must discharge. The focal point for this activity is the Joint Chiefs of Staff (JCS); in particular the staff functions to the JCS. At this level priorities are set consistent with funding expectations and apportionments to the services in subsequent US fiscal years. Industry has opportunity in rare instances to make input to this process; usually these deliberations are conducted without any participation by industry. It is imperative that contacts between the government-military and industrial concerns that can contribute be carried forward at this early time in order to achieve affordable systems. There are steps that industry can implement in the absence of meaningful contacts as are defined later in this paper; however such undirected efforts may be inefficient if not downright wasteful.

Those military missions that survive needs identification are characterized by the appropriate service in terms of required capabilities and the types of hardware and software necessary to realization of required capabilities. This step involves assessment of the availability of technical achieve-

ments and technology to provide a high degree of confidence that equipment can be produced that adequately performs the mission. The military frequently benefits from interfaces with industry in accomplishing this chore but in the typically guarded manner engendered by concern over yet to come competition as described above.

It is government's task to place a value on the required capabilities to be acquired in the form of that portion of the defense budget to be committed for a period of years to procure adequately performing equipment. The important part of "adequately perform" from an affordability standpoint is the prospect that success will be obtained on schedule and for the money allocated to the task. A topdown definition of the desired life cycle funding profile is the result of this effort.

Consistency in the weapon system acquisition goals and objectives is a necessary ingredient of a stable life cycle. Typically goals and objectives are not sustained as the turmoil of services rivalries and national politics come into play. This is not to say that changes cannot be introduced as we learn our way through the acquiring of a particular weapon system. It is government's job to set and maintain goals and objectives; and it is government's job to accurately convey them to industry if affordable weapons are to be acquired. Further it is government's job to develop the apparently non-existent process needed to provide a degree of stability to weapon system goals and objectives.

The goals and objectives for a given weapon system convert to specific requirements for the procurement of the required end product. Retaining the requirements as a consistent set of drivers for the procurement is government's job; this includes changing procurement practices as necessary to protect the government's interest and investment in a particular approach to the solution being developed. This sounds like heresy and yet a controlled method for accomplishing changes in procurement appears to be a "must" for gaining truly affordable systems. It will benefit both industry and government through added stability during acquisition and throughout the system life cycle. Industry has invested millions of dollars over the years in preparing to compete for weapon systems that never materialize because political forces destroy the requirement and abort industrial efforts to satisfy that requirement. We as a nation must eliminate false starts.

It is essential that government-military work in advance of a competition with qualified aerospace contractors to define and validate an acquisition approach on the bases of available technology, available promising concepts and programatics that appear to be consistent with the resources that are to be committed. We must tone down overly restrictive measures invoked in the name of defending the yet to come competition; totally open and even handed communications and interfaces by the procuring agency with all contenders will avoid any compromise to competition or proprietary interests.

Possibly the greatest cancer that has evolved in our way of doing business is the advent of parasitic layers of System Engineering and Technical Assistance (SETA) contractors

and other brands of support contractors. These organizations were invented to provide technical assistance to government program managers either lacking adequate staff or devoid of the inherent technical capability to discharge the needed duties. These support contracts have grown at a tremendous rate as it became ever more fashionable to layer them over prime contracts. The distrust of major aerospace contractors has been promoted over the years by their own miss-steps, mistakes, anti-defense political opportunism and an anti-defense media bias. The need for so-called oversight to protect the taxpayers interests is overblown and this hierarchy of overseers is nothing more than a very little or no-value-added tax on all our weapon system developments. To really gain the affordable weapon systems we seek in the future, it is necessary for government-military to take the drastic steps required to destroy this habit of carrying no-value-added contracts along in funding profiles. In difficult funding shortfall years in the past, government-military project leaders have agonized over funding their project prime contractor versus the gaggle of support contractors who are onboard the effort. Some of these support contracts have assumed the aura of a "mandated" funding requirement. The government must eliminate these practices. The advent of integrated product and process development practices in the DOD is the route to reform; in this instance reform is achieved through the organizing of programs with IPTs with only the required correct disciplines included from government-military and industry.

Most importantly, government must develop a means for avoiding the incessant perturbations to funding profiles and hence program plans and weapon systems performance capabilities. At present these perturbations are traceable to administration/congressional politics, services rivalries and or changes in military commanders or command structure. The concept "for the good of the government" is familiar to most contractors as it is frequently invoked as a way to explain away adverse decisions. It seems axiomatic that our system of bureaucracy, partisan politics and the entrenched establishment of professional civilian and military defense leadership inevitably results in changes for the good of someone in the chain and maybe sometimes for the good of the government. It is not clear that changes for the good of the republic occur very often. Perhaps use can be made of public law to define and protect decisions essential to the nation as is currently done in other western countries. The United Kingdom defines "staff targets" to engender laws to protect a long term development effort. This entails writing into law a program plan and master schedules, full participation of government agencies and needed contractors, facilities to be employed and the multi-year funding profile, as a minimum. The program plan contained in the law must set acquisition goals and objectives, define the performance required of the system, and layout the various phases of the life cycle. Typically a law governing the life cycle of a weapon system must encompass as many as twelve to fifteen years which means many elections in our country. In order to pass such a law, a consensus of the opinions of lawmakers in both houses would be required; this aspect would

give the law the support it needs to survive. Anything less means no weapon system, but it also means no false initiatives. In the name of affordability for all, measures such as suggested are needed to enable the orderly pursuit of affordable weapon systems

The Role of Industry in Achieving Affordable Weapon Systems

Figure 3 presents five things industry can address in conjunction with the government-military to help in the evolution of requirements for new weapon system acquisition candidates. Industry needs to complete several steps in parallel, and if permitted, in conjunction with the government. The preparation to be a team player with the government-military, as missions, technology assessments, affordability assessments and funding profiles are defined, requires that industry work (sometimes without any useful contact with government-military) to get up-to-speed. It is important for those aerospace concerns that have interest in advanced weaponry (and government's probable needs) to track and support military needs assessments and mission identifications to the extent possible even without many direct exchanges with knowledgeable government personnel. These analytical and planning ventures provide a basis for meaningful contacts when the opportunity arises to forge a partnership with the government-military. Industry should make an independent effort to characterize military missions they have defined themselves in terms of required capabilities and the hardware technology and software technology necessary to deliver required capabilities. Industry should conduct design-to-cost trade studies to produce a data bank to enable selection of the best hardware/software solution to accomplish an intended mission. These preparations should be supplemented by identification of the technological requirements for that weapon system that will satisfy mission needs and affordability objectives; and comparisons should be made with state-of-the-art and of course our own corporate technology stockpile. Industry can complete preparations to enter into a partnership with the government-military by defining a plan to accomplish transition of required technology to production utilization. All the steps below can be taken in the nearly complete absence of direct personal contacts with government-military representatives.

- Track and support military needs assessments and mission definitions
 - Prepare to be a team player when Government-Military is ready
 - *Complete this work on corporate resources to become ready*
- Conduct your own design-to-cost studies of candidate weapon systems that are within your corporate goals and objectives
- Make application of your company technological expertise to candidates favored because they match corporate goals
- Develop your plan of action for sharing the results of your work with customers; highlight your affordability measures
- Complete all this effort in the absence of direct contacts with customers; these preparations enable entering into a partnership with the Government-Military

Figure 3. Preparations Industry Should Complete in Coordination and in Parallel with the Government-Military

Naturally contacts need to be sought to help maintain the direction of our work.

Figure 4 presents ten steps industry can implement to develop provisions that yield affordability without immediate participation on the part of government. This is a tabulation of measures that industry needs to implement and share with government-military personnel. These items might well be characterized as the cornerstone combination of affordability actions that either have been or can be pursued by industry. The list is far from complete; it does however, provide a perspective on those things that can and should be done. The work completed to develop your company's cornerstone affordability projects most certainly is to be presented to the government-military well in advance of pending competition.

Identification of streamlining, or if you prefer IPD, tactics to improve design practices, tooling development, procurement practices, fabrication, assembly, testing, integration, delivery and operational support is the means to uncover the most powerful contributors to affordability. Time is money is an accurate statement and hence time saved is money saved. It is against this backdrop that a majority of affordability gains are made. The axiom is "eliminate time wasted" and the avenue to cost saving is in sight. The consequence of this factor is that the earliest looking for improvement is directed at our processes and procedures. Beyond that however there are other actions to be taken as shown on Figure 4 including automation of people intensive design work to the extent practicable; organizing to make use of Integrated Product Development (IPD) methodology (where it is noteworthy that once a contract is awarded Government-Military persons are members of the IPD team); identifying and tracking lessons learned from prior experiences and supplementing those lessons with results of selected benchmark measurements; and introductions of innovations in design, tooling, manufacturing and inspection.

Labor intensive functions are necessarily costly; not that the products that come from these tasks are any less valu-

- Identification of streamlining tactics to improve design practices, tooling development, procurement practices, fabrication, assembly, testing, integration, delivery and operational support.
- Eliminate non-value added activities and paperwork
- Seek out people-intensive operations and find a means to use automation to relieve intensity; reduce part counts.
- Take advantage of lessons learned from your own and the experiences of others; use selected benchmark measurements to improve your processes.
- Always begin with procedures and processes in the search for ways to conserve time and person count and hence reduce costs.
- Use electronic collection and computational techniques for data management
- Develop your list of preferred (for good reasons) suppliers including small/small disadvantaged businesses; develop long term relationships.
- Prepare and implement training programs for your people
- Introduce paper-free management control processes for engineering and in the factory
- Establish a working partnership in affordability with the Government-Military

Figure 4. Affordability Measures That Industry Must Develop and share With the Government-Military

able. The goal is to obtain these products in a different manner to avoid expenditures of as much people-time as heretofore has been required. Streamlined and automated procedures and processes inherently reduce person loads needed to acquire the desired product. Similarly reductions in the number of parts in a structural and/or avionic assembly saves labor and time. This basic idea permeates the whole of the approach to becoming a more affordable supplier of goods and services to the Government; and the task starts here.

Other steps that may be taken include improvements to management methods: 1) use of electronic collection and computational techniques for data acquisition, development, organizing and presentation; 2) development of preferred suppliers including small/small disadvantaged businesses that deliver quality affordable products because they share our vision; 3) preparation and implementation of training programs for inculcation of the changing culture to the work force; 4) introducing paper-free operations into management control processes, communications and manufacturing thus increasing reliance on electronic networking; and 5) the preeminent step of preparing a strategy and pursuing it to promote and establish a working partnership in affordability with the Government-Military.

Figure 5 presents an overview of achievements that have already been realized in industry. These measures are either in place now or have recently been employed on contracted

- Process-Based management in place at many aerospace firms
- Design-to-cost processes in place at many aerospace firms
- Design-for-manufacturing/producibility in place at many firms
- Integrated "Design-to" processes incorporating form, fit, function and affordability in place at many firms
- Specialized factory and manufacturing streamlining provisions in place include
 - Virtual manufacturing; simulations of design-manufacturability enable trades to select most affordable solutions
 - High speed machining capabilities improve affordability by saving time
 - Certification of "regular" suppliers of unique equipment items saves time
 - Formally introducing "lessons learned" in all phases of activities avoids trouble and saves time
 - Incorporating best practices identified in all phases of activities avoids trouble and saves time
 - Utilization of results from benchmarking "measurements/comparisons" improves procedures and processes
- Introduction of low cost composite tooling
 - Combined plastics and metallics
 - Expendable tooling for limited production quantities; short life expectancy
- Replacement of labor intensive, complex and time consuming Material Review Board/ Corrective Action procedure with paperless process
- Engineering design and release employing paperless CAD/CAM procedures
- Application of the concepts advanced in DOD Guide to Integrated Product and Process Development (5 February 1996)
 - Program level IPTs and sub-tier IPTs
 - The Government-Industrial team to facilitate acquisition reform and to facilitate a carefully orchestrated downsizing of industry
 - Joint Government-Military and industry IPTs reach shared decisions in real time which saves time and hence resources
 - Expectations include lowered costs, higher quality and adherence to schedules

Figure 5. Achievements to Date By Industry In Affordability

efforts in industry. These implementations are representative of actions taken by the industrial community to save time, reduce the dependence on personnel and increase efficiency. Plenty of room continues to exist for new ideas and innovative processes and procedures to be introduced into operations. It is noteworthy that the majority of the achievements that have been made are pertinent to airframe and component development and/or acquisition for aircraft systems. Some new initiatives have been started that turn our attention to missiles or, more pointedly, theater and strategic interceptor systems.

Figure 6 presents those steps that industry has taken to improve the affordability of missile defense systems. The list is long and broadly applicable to missiles for all purposes in some part; however the items shown were selected because of their immediate utility to defensive interceptor

- Reduced parts counts and reduced tight tolerances
 - Advanced materials and fabrication methods
 - Near net shape structures of beryllium, finish machined
 - Cast ceramic thrustors and nozzle liners
 - Optical quality sapphire IR windows grown from crystals; trimmed and polished
 - Ablating thermal protection sleeves; layed-up, hydroclave cured and finish machined
 - Streamlined procedures for fabrication, assembly, checkout and integration
 - Use of deliverable articles as "tooling"
 - Use of short lived expendable tooling and assembly jigs for limited production runs
 - Use of geometric dimensioning and tolerancing; optimization of fits and tolerances and acceptable variations in finished parts
 - Paperless MRB actions
- Kill vehicle developmental innovations
 - Miniaturized avionics, fluidics and propulsive components
 - Specialized factory and manufacturing streamlining provisions (Reference Figure 5)
 - "Wooden round" assembly method; no field joints
 - Implementation of SEI level 3 and higher software processes
- Booster, interstage and ascent shroud developmental innovations
 - Use of composite materials in flight articles
 - Producibility procedures and processes
 - Horizontal integration of stages, interstages and fairings
 - Reduced labor intensive operations through reduced numbers of larger parts and automated procedures with specialized jigs and fixtures
- Extended NDT through automated ultrasonic scanning, radiography and the imposition of proof loads
- Deployment and operations in the field/maintenance
 - Built-in-test (BIT) for total readiness checkout
 - Automated procedures and processes to the maximum extent
 - Minimize maintenance activities in the field; push all maintenance back to depots; assign contractor facilities to be depots. Put the wooden round concept in place from the start
 - Minimize the requirements for people on-site
- Early risks identification avoid cost and schedules growth
 - Risk assessments and mitigation planning from the start
 - Lessons learned, benchmarking and best practices apply in the form of an accumulated data base drawn from similar program experiences
- Advancements in predicting life cycle costs (LCC) from the bottom up
 - Cost realism through careful definition of the concept, integrated master schedule (IMS) and the integrated tasks and master plan (ITAMP)
 - Your own records of the accuracy of prior cost quotations; and the proceedings of the Multi-Association Industry Task Force

Figure 6. Examples of Affordability Contributions From Industry Applicable to Missile Defense Programs

development and production. Significant progress is available for the next generation defensive interceptor development effort. The interceptor this figure is aimed at is a relatively small booster delivering a hit-to-kill payload or kill vehicle (KV) that employs miniaturized S/M/LWIR seeker technology. This type of interceptor promises to be the most affordable means for completing intercepts in the theater battlefield environment and in defense of CONUS. The key to realization of the affordable program desired by Government-Military and industry is carefully planning all aspects of development and production from the outset to take advantage of the new ideas and innovations now at our disposal. Of paramount importance is the formation of a partnership among the Government-Military and the selected prime contractor and that prime's team of suppliers. An environment of mutual trust and shared goals and objectives is crucial to gaining the ultimate reward, a truly affordable interceptor system.

Summation

A considerable number of steps forward have been made. Much remains to be achieved in order to realize the pinnacle of affordable acquisition of defensive interceptor systems. The purpose of this paper is to clarify the roles of all participants in the quest for affordability *which is nothing more than a not-too-difficult management problem*. The bottom line is that we all are players and have a contribution to make. The scope of our investigations into the how of affordability is all-inclusive and no stone can be left unturned. The government-military cannot say to industry "we need and require of you serious cost savings" and yet continue to tolerate the unwarranted proliferation of support

contractors, continuous changes in requirements and constantly changing funding. Industry on the other hand is obligated to invest time, personnel and profit dollar resources in preparing to be a strong teammate for the government in the ultimate capture of the affordable interceptor system.

The defense community is faced with a considerable management issue; it does not appear to be insurmountable; and if we as a group accept the challenge the expectation is that we can succeed.

Figure 7 sums up the ground we have covered in terms of the need for funding profile stability, the need for a real partnership between government and industry, and the expansion of affordability investigations to further encompass interceptor missile systems.

- Government-Military and Industry are making great strides forward
- But much remains to be accomplished
 - Provision of stable funding over the duration of total contracts
 - Encourage the partnership of Government-Military and Industry; this must start in the requirements development phase prior to competition
 - Continued development of measures to enhance cost realism
 - To date innovations for affordability of aircraft systems have dominated
 - The Affordable Multi-Missile Manufacturing (AM3) Advanced Technology Demonstration (ATD) program promises to produce significant missile related results
 - 25% reduction in unit costs for ongoing production programs
 - 50% reduction in development and production costs for new missiles
 - Reduced dependence of unit cost on lot size
 - 50% reduction in development cycle times
 - Increased quality of missile seekers

Figure 7. Summation